



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/072,811	02/08/2002	Yiqiong Wang	LIGHT1900-2 (LIGHT1901)	1062
7590 05/11/2004			EXAMINER	
Law Offices of Travis L. Dodd A Professional Corporation 2490 Heyneman Hollow Fallbrook, CA 92028			CULBERT, ROBERTS P	
			ART UNIT	PAPER NUMBER
			1763	

DATE MAILED: 05/11/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/072,811

Applicant(s)

WANG, YIQIONG

Examiner

Roberts Culbert

Art Unit

1763

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3,5-37 and 39-64 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3,5-37 and 39-64 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 0404.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____.

Art Unit: 1763

DETAILED ACTION

Response to Arguments

Original Claims 1-39, were previously rejected over various combinations of U.S. Patent 4,776,661 (Handa) U.S. Patent 5,874,362 (Wong), U.S. Patent 6,235,214 (Deshmukh) and U.S. Patent Application 2001/0001652 (Kanno). Since Handa does not teach forming a waveguide from silicon, the rejections have been withdrawn.

Applicant's arguments and remarks regarding the rejections over U.S. Patent 6,303,512 to Laermer have been fully considered but are moot in view of the new grounds of rejection cited below.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-21, 40, and 42-64 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

There is no support in the specification for an *etching medium consisting of a fluorine containing gas and a partial passivant* as recited in independent Claim 1. Although the specification teaches, for example, that oxygen may be excluded, the specification does not indicate that all other materials are excluded from the etching medium.

There is no support in the specification for an *etching medium consisting of SF₆, a partial passivant and one other medium* as recited in independent Claim 47. Although the specification teaches, for example, that oxygen may be excluded, the specification does not indicate that all other materials are excluded from the etching medium.

Art Unit: 1763

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

Claim 26 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 26 recites the limitation "the fluorine containing gas". There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-3, 5-12, 14-21, 40, 42, 43, 45, 46-56, and 58-64 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 4,927,781 to Miller in view of U.S. Patent 5,498,312 to Laermer

Referring to figures 1-3, Miller teaches a method for forming an optical component that includes forming an oxide mask (16) over a light-transmitting medium (14) so as to protect a region of the light-transmitting medium where a waveguide is to be formed; and applying an etching medium to the light-

Art Unit: 1763

transmitting medium so as to form one or more waveguide surfaces including vertical (Col. 3, Lines 48-49) sidewalls and facets by plasma etching (Col. 3, Lines 35-57). Miller does not teach the etching composition for the plasma etching, however, Miller does teach that it is well known in the art of forming waveguides to use silicon for the light transmitting medium (Col. 1, Lines 20-43).

Laermer (5,498,312) teaches a method of forming vertical features (Fig.1) in silicon by applying an etching medium including a fluorine-containing gas (Col. 2, Lines 44-48) such as SF_6 or NF_3 , and a partial passivant (Col. 2, Lines 49-55) such as CHF_3 or C_4F_8 . The mixture may optionally also contain argon nitrogen and/or oxygen (Col. 2, Lines 54-62). Since Laermer (5,498,312) teaches a gas mixture comprising an etching gas and a passivating gas optionally mixed with other gasses, it would have been obvious to one of ordinary skill in the art at the time of invention to use a gas mixture consisting of only a fluorine containing gas and a partial passivant for situations that do not require improvement in stability or roughness influence. See (Col. 5, Lines 25-35). Further it would have been obvious to one of ordinary skill in the art at the time of invention to use a gas mixture consisting of only a fluorine-containing gas, a partial passivant and one other medium since Laermer teaches that the composition contains an etching gas and a passivating gas and may for example contain argon, N_2 and/or O_2 . It is clear, for example, from (Col. 2, Lines 44-62) and (Col. 5, Lines 21-35) of Laermer, that oxygen, nitrogen and argon are optional in the etch process since Laermer states, for example, that the etch mixture "may be advantageously influenced by minor admixtures". It is clear from Laermer that only an etchant and passivant are required for a preferred vertical sidewall etching process.

It would have been obvious to one of ordinary skill in the art at the time of invention to use the silicon etching composition of Laermer (5,498,312) to etch the silicon light-transmitting medium of Miller because Laermer demonstrates a method that is exceptionally well suited to fabricating the vertical silicon device structures of Miller. Furthermore, Laermer provides the necessary details in order to etch the vertical silicon structures. One of ordinary skill in the art would have been motivated to use the etching medium of Laermer in order to provide a composition that will etch the silicon light-transmitting medium of Miller with vertical sidewalls and at high etch rates as taught by Laermer.

Art Unit: 1763

Regarding Claims 1, 40, and 47, Laermer (5,498,312) does not teach the limitation of smoothness less than 220nm or 50nm, however, the limitation is inherent in Laermer because smoothness is a latent property resulting from etch composition and process conditions, and the method steps of Laermer include an etch composition and process conditions that are the same as in the claimed invention.

Regarding Claims, 9-11, 15-17, 54-56, and 59-61, Laermer teaches that the etching medium is applied at a pressure of 1-100 μ bar and ratios of partial passivant to fluorine containing gas of 30:1 to 1:4 (Col. 5, Lines 21-27)

Regarding Claims, 21 and 64, Laermer teaches that an inductively coupled plasma reactor may be used with the invention. (Col. 4, Lines 19-21)

Regarding Claims 19, 20, 62 and 63, Laermer teaches that either a photoresist (resist) or oxide mask (SiO_2) may be used with the invention.

Regarding Claims 12, 14, and 58, Laermer teaches that the etching medium may also contain a noble gas such as argon. (Col. 2, Lines 54-56)

Regarding Claim 18, Miller teaches that the surface of the light transmitting medium is masked to protect a region where a plurality of waveguides are to be formed, and the etching medium is applied so as to form one or more surfaces on at least one of the waveguides. See Figures 1-3 for example.

Regarding Claim 43, it may be assumed the one or more surfaces are formed in a single etch step since it is not indicated in Laermer that multiple etching steps are necessary.

Regarding Claims 45 and 46, it may be assumed that conditions such as pressure remain constant since Laermer does not indicate that etching conditions should be changed during the etching process.

Claims 22, 26-30, 32-37, 39, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 4,927,781 to Miller in view of U.S. Patent 6,127,278 to Wang.

Referring to figures 1-3, Miller teaches a method for forming an optical component that includes forming an oxide mask (16) over a light-transmitting medium (14) so as to protect a region of the light-

Art Unit: 1763

transmitting medium where a waveguide is to be formed; and applying an etching medium to the light-transmitting medium so as to form one or more waveguide surfaces. Referring to Figure 1, Miller likewise shows obtaining an optical component having a light-transmitting medium (14) positioned over a base (10) and applying an etching medium to the light-transmitting medium so as to form one or more waveguide surfaces including vertical (Col. 3, Lines 48-49) sidewalls by plasma etching (Col. 3, Lines 35-57). Miller does not teach the etching composition for the etching the vertical sidewall structure, however, Miller does teach that it is well known in the art of forming waveguides to use silicon for the light transmitting medium (Col. 1, Lines 20-43).

Wang et al. teaches a method of etching a vertical side-walled structure with an etch composition including Si_2F_6 and one or more partial passivants.

It would have been obvious to one of ordinary skill in the art at the time of invention to use the silicon etching composition of Wang to etch the silicon light-transmitting medium of Miller because Wang demonstrates a method that is exceptionally well suited to fabricating the device structures of Miller. For example, Wang teaches a method of etching a ridge structure with vertical sidewalls in silicon. Furthermore, Wang provides the necessary details in order to etch the structures. One of ordinary skill in the art would have been motivated to use the etching medium of Wang in order to provide a composition that will etch the silicon light-transmitting medium of Miller with vertical sidewalls and at high etch rates as taught by Wang.

Wang does not teach the limitation of smoothness less than 220nm or 50nm, however, the limitation is inherent in Wang because smoothness is a latent property resulting from etch composition and process conditions, and the method steps of Wang include an etch composition and process conditions that are the same as in the claimed invention.

Regarding Claims 28-30 Wang teaches a pressure of 1-100mTorr for the etching process.

Regarding Claim 32, Wang teaches that the etching medium also may include a noble gas

Regarding Claims 33-35 Wang teaches a ratio of partial passivant to fluorine containing gas of from 0.1 to 10.

Art Unit: 1763

Regarding Claims 36 and 37, Miller teaches that a mask is formed so as to protect a region of light transmitting region where a plurality of waveguides are to be formed and the etching medium is applied so as to form the at least one surface on a plurality of waveguides.

Regarding Claim 39, Wang teaches that an inductively coupled plasma reactor may be used with the invention. (Col. 3, Lines 29-35)

Claims 22-25, and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 4,927,781 to Miller in view of U.S. Patent 5,498,312 to Laermer, as applied above, and in further view of U.S. Patent 6,127,278 to Wang.

As applied above, Miller in view of Laermer teaches the method of the invention substantially as claimed, but does not teach an etching medium including Si_2F_6 and one or more partial passivants.

Laermer teaches that a source gas for the anisotropic etching of silicon includes a fluorine-producing etching gas such as SF_6 , NF_3 , CF_4 , and a passivating gas. (Col. 3, Lines 33-38)

Wang teaches that SF_6 , NF_3 and Si_2F_6 are also suitable fluorine containing source gasses for anisotropic etching of silicon with an etchant and a passivant. (Col. 4, Lines 60-62)

It would have been obvious to one of ordinary skill in the art at the time of invention to use SF_6 , NF_3 , CF_4 , or Si_2F_6 as the fluorine-containing source in the method of Laermer since Wang teaches that SF_6 , NF_3 and Si_2F_6 are equivalent fluorine containing source gasses for anisotropic etching of silicon with an etchant and a passivant. (Col. 4, Lines 60-62)

It has been held that an express suggestion to substitute one equivalent component or process for another is not necessary to render such substitution obvious. *In re Fout*, 675 F.2d 297, 213 USPQ 532 (CCPA 1982).

Regarding Claims 23 and 24, since it would have been obvious to one of ordinary skill in the art at the time of invention to use SF_6 , NF_3 , CF_4 , or Si_2F_6 as the fluorine-containing source in the method of Laermer as applied above, it would have been obvious to one of ordinary skill in the art at the time of invention to use an etching medium including C_4F_8 , or CHF_3 as Laermer teaches that these passivants are suitable for etching silicon with fluorine based etchants such as SF_6 , and NF_3 .

Art Unit: 1763

Regarding Claim 25, since it would have been obvious to one of ordinary skill in the art at the time of invention to use SF_6 , NF_3 , CF_4 , or Si_2F_6 as the fluorine-containing source in the method of Laermer as applied above, it would have been obvious to one of ordinary skill in the art at the time of invention to use an etching medium including Si_2F_6 where the etching medium excludes oxygen. Laermer indicates that application of a fluorine-gas based etchant and passivant to silicon may include oxygen. It is clear from (Col. 2, Lines 44-62) and (Col. 5, Lines 21-35) of Laermer, that oxygen, nitrogen and argon are optional in the etch process since Laermer states, for example, that the etch mixture "may be advantageously influenced by minor admixtures". It is clear from Laermer that only an etchant and passivant are required for a preferred vertical sidewall etching process.

Regarding Claim 31, since Wang teaches that a mixture of SF_6 , NF_3 , SiF_4 and Si_2F_6 can be used (Col. 4, Lines 60-64) as the fluorine containing etch gas, It would have been obvious to one of ordinary skill in the art to use a mixture of SiF_4 and Si_2F_6 for example, as Wang teaches that such a mixture is well suited to anisotropic etching of silicon with an etchant and a passivant.

Note that even if Wang did not teach the equivalence of the etch gasses and mixtures thereof, it would have been obvious to one of ordinary skill in the art at the time of invention to form such a mixture since it has been held that combining equivalents known for the same purpose is *prima facie* obvious. See MPEP 2144.06.

Claims 13, 44 and 57 are rejected under 35 U.S.C. 103(a) as being obvious over U.S. Patent 4,927,781 to Miller in view of U.S. Patent 5,498,312 to Laermer et al. as applied above, and in further view of U.S. Patent 6,303,512 to Laermer et al.

As applied above, Miller in view of Laermer (5,498,312) teaches the method of the invention substantially as claimed, but does not teach etching continuously or using SiF_4 or SiF_6 in the etching medium.

Regarding Claims 13 and 57, Laermer (6,303,512) teaches a method of forming vertical features in silicon using an etching medium comprising a fluorine-containing gas such as SF_6 or NF_3 and a

Art Unit: 1763

passivant such as CHF_3 , C_4F_8 , CF_4 , C_2F_6 , or C_3F_6 . Oxygen and a secondary reactant such as SiF_4 are also optionally used for sidewall passivation (Col. 2, Lines 40-53).

Since Laermer (6,303,512) teaches the same etching composition and conditions as Laermer (5,498,312), it would have been obvious to one of ordinary skill in the art at the time of invention to use a secondary reactant such as SiF_4 in the method of Laermer (5,498,312) because Laermer (6,303,512) teaches that a secondary reactant may be advantageously used for sidewall passivation.

Regarding Claim 44, Laermer (6,303,512) also teaches that the composition may be applied continuously or in an alternating fashion (Col. 1, Lines 30-57; Col. 3, Lines 55-65, and Col. 4, Lines 20-37).

Since Laermer (6,303,512) teaches the same etching composition and conditions as Laermer (5,498,312) It would have been obvious to one of ordinary skill in the art at the time of invention to use continuous application of the etching medium as suggested by Laermer (6,303,512) in the method of Laermer (5,498,312) in order to provide prevent needle formation as suggested by Laermer (6,303,512)

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

U.S. Patent 6,380,095 to Liu et al teaches a method of anisotropically etching silicon using an etching medium comprising a fluorine-containing compound, a silicon-containing compound and oxygen.

U.S. Patent 5,423,941 to Komura et al. teaches a method of anisotropically etching silicon using an etching medium comprising HBr , SF_6 , SiF_4 and O_2 .

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Roberts Culbert whose telephone number is (571) 272-1433. The examiner can normally be reached on Monday-Friday (7:30-4:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory Mills can be reached on (571) 272-1439. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 1763

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

R. Culbert



GREGORY MILLS
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700